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Cy 3 of 8

6 AUG 1976

MEMORANDUM FOR: Director

FROM : Ernest J. Zellmer
Associate Deputy Director for Science
and Technology

SUBJECT : OWI Comments on General Keegan's Message
re Backfire Analysis

25X1A 1. Attached are OWI comments on General Keegan's critique of the Soviet Backfire bomber analysis done by CIA and [redacted]. Quotes from General Keegan's message are shown in italics.

2. In general, it appears that General Keegan is of the mistaken opinion that the analysis is based on a number of unfounded assumptions. In fact, the analysis was initiated with the intent of reducing the number and significance of assumptions that were necessary in previous analyses.

25X1A 3. The [redacted] work is an input to a comprehensive OWI study. This study will include our uncertainties about various characteristics and show the sensitivity of the aircraft's estimated range to these uncertainties. We expect the study to be completed in September.

25X1 Attachment:

[redacted] dtd 5 Aug 76

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Ernest J. Zellmer

C/DSD/OWI/[redacted] (5Aug76)

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AND METHODS INVOLVED

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COMMENTS ON AIR FORCE REVIEW
OF CIA BACKFIRE ANALYSIS

During the past four years, independent studies by Boeing, North American Rockwell, General Dynamics (the only US designers experienced in strategic bomber development), the RAF, and the Foreign Technology Division (FTD) have agreed without exception that the Backfire has an unrefueled intercontinental range capability plus a demonstrated capability for aerial refueling for more range extension.

All of these studies were based on the same assumptions -- most of the available volume is reserved for fuel; the thrust characteristics of the engines are those of an uprated SST engine; optimum takeoff and cruise aerodynamics apply. No attempt was made to validate these assumptions/

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Similarly, we understand that recent Douglas Aircraft in-house analytical data accord the Backfire considerably greater range capability than

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Douglas Aircraft is performing NTA studies for the DDR&E. They are using Backfire characteristics in their studies, but we understand that they are not generating those characteristics themselves.

In 1975, Dr. Schlesinger directed a completely independent audit and separate parametric analysis of all previous work accomplished on the Backfire. The conclusions, which were reported to the White House, validated the earlier intercontinental range findings for the Backfire.

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This analysis did not incorporate

Even so, it was reported to have concluded that the Backfire's range was 300 to 400 miles less than the FTD estimate and was denigrated by the Air Force at that time.

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With the introduction of the Backfire B model, the Soviets achieved significant range enhancement by redesigning the wing, extending the wing tips four feet on each end and by eliminating the high drag-inducing landing-gear pods.

We find no evidence that the range of Backfire B was significantly enhanced. A yet unpublished NASA wind tunnel study is reported to show that the benefits of a longer wing and removal of landing gear pods were off-set by increased drag from the larger wetted area of the wing.

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We now have reason to believe that additional improvements are being made to the B model.

We know of no evidence that improvements in range and performance are being made to Backfire B. There has been reporting which suggests to us that a new variant may be under development, but we expect this to be an ECM or reconnaissance version.

Also, with 500-800,000 sq ft of production capability now being added to the Kazan Backfire production plant, the Soviets are anticipating a major increase in Backfire production.

We do not necessarily equate the new construction with increased Backfire production. The floorspace will be increased by about 20 percent. It could be used to increase production capacity, or it could be used for post-production maintenance on completed aircraft. In any case, there is no correlation between increased production and improved performance.

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The latest [] analysis of Backfire appears to be largely based on a single source of information []

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This statement is entirely false. Our reanalysis of Backfire incorporates and is consistent with all known data from all sources.

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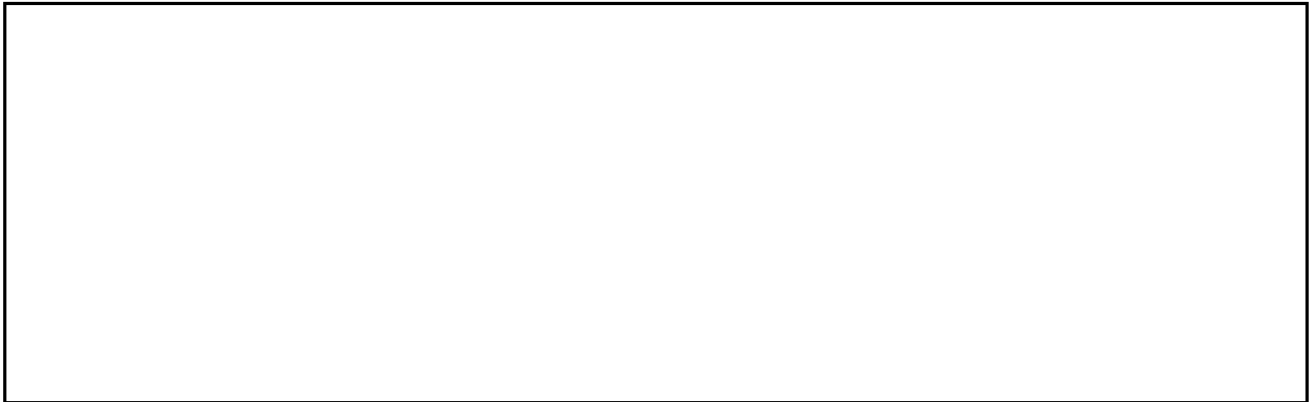
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Due to the extremely limited sample of analytical data utilized, it was necessary for the contractor to make a number of assumptions and analytical judgments that strongly influenced the derived range/radius results. These key judgments were made, with but one exception, in a range-degrading direction and were made in opposition to a vast body of existing additional data utilized by all other contractors who have examined the Backfire.

The assumptions made in our analysis were far fewer and much less significant to the results than those in previous analyses. We believe

is far superior to engineering judgments based on US experience. All other contractors have used a body of additional assumptions but not additional data.

That such assumptions were made can now be clearly inferred from the analysis to date. Most are considered somewhat questionable in the light of accepted aeronautical engineering analysis practices and demonstrated Soviet technical competency.

We are not certain what is meant by this statement. If "accepted aeronautical engineering analysis practices" means that we are using a different method of analyzing Soviet aircraft, then it is not surprising that what are termed "assumptions" are being questioned. However, we find no discrepancy with demonstrated Soviet capabilities.

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For instance, [] apparently -- and we think erroneously --
assumed []

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(B) two aircraft with significantly different wings have the same lift characteristics;

This is not an assumption. Fundamental aerodynamic theory shows that the lift characteristic used in our analysis will differ by no more than about 1.5 percent for the two aircraft.

(C) the aircraft cannot rotate more than seven degrees at takeoff;

[]
Our analysis [] shows that Backfire would drag its tail at about 9.5 degrees rotation on a smooth and level runway. We do assume that they would have a 2 degree or so safety margin.

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(D) there is no benefit from ground effect on the lift at takeoff;

Ground effects were omitted from the [] input because they consider that true ground effects are difficult to predict without extensive wind tunnel analysis. Also there are both favorable and unfavorable aspects which can result in no net gain. CIA does estimate some ground effect, and we incorporate it into our final analysis.

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and (E) takeoff speed can be estimated precisely.

We are unsure of the term "precisely". We believe that we can determine takeoff speed to within 5 knots.

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(E) Secondly, it is also claimed that the aircraft cannot rotate to an angle of more than about seven degrees at takeoff. This was concluded from an assumed landing gear location and configuration.

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The landing gear location and configuration was not assumed in our analysis.

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Apparently there is a difference in judgment as to what constitutes safe engineering design margins and what type of airfields Backfire was designed to operate from.

(G) When an aircraft operates very near or on the ground, an additional lifting force is present called ground effect. This effect is usually on the order of 10-20 percent. Although one must be careful when applying this benefit, it is worth considering when assessing maximum capability.

We calculate a 6 to 7 percent increase in lift due to ground effect. This increment is included in CIA's final analysis.

(H) Another anomaly in the [] analysis involves a judgment that the flap-generated lift improvements for Backfire is the same whether the flaps are set at 27 degrees or 39 degrees. This is totally inconsistent with the type of system observed on Backfire B. It is, in fact, inconsistent with nearly every flap system in use.

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Theoretically the flap system we believe is used on Backfire could have a 6 percent increase in lift for the two settings.

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(I) An open comment by Tupelov is noteworthy when considering the maximum weight of Backfire B. He stated that the Charger A supersonic transport landing gear was designed to sustain aircraft weighing up to 331,000 lbs. This landing gear is of similar configuration and size to that of Backfire B. If Backfire B did weigh no more than 230,000 lbs, we would be required to conclude their 44 percent over-design weight penalty was accepted rather than to design a new landing gear. This seems inconsistent with past Soviet practice.

There are enough differences in the Charger A and Backfire B landing gears to confirm that they are not the same. We believe that Backfire's gear is designed for very different types of airfields and operating conditions. For example, the tire pressure for Backfire likely would be lower to allow for rougher runways, and the allowable weight would be reduced accordingly.

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[redacted] postulates a Backfire B using an engine of less thrust than Charger A; however, [redacted]

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We agree that the Backfire B engine unit [redacted] is longer than Charger A and that the nozzle is larger in diameter. [redacted]

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[redacted] The maximum thrust is greater than that of Charger A, but it is only used at high altitudes and speeds. This phenomenon is a characteristic of all known Soviet engines. FTD has shown this in their hardware exploitation reporting. It is not unusual for the same engine to have different length afterburners in different applications, particularly when going from civilian to military requirements.

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The [] analysis produced additional results which are almost completely unacceptable in terms of commonly accepted aeronautical engineering norms. For instance, the analysis assumes that: (A) a double-slotted flap with leading-edge slots is no better than a plain flapped wing. (B) there is no difference in lift between 27 degree and 39 degree flap settings. (C) the Backfire landing gear is overdesigned by 45 percent. (D) larger engines give no more thrust than smaller ones of the same type. (E) only two-thirds of the available volume for fuel is used on a supersonic aircraft.

This paragraph is a total misstatement. These were not assumptions. The analysis found no evidence of a double slotted flap and determined that a wing with single-slotted flaps was consistent with all of the data. We did not assume there was no difference in lift between flap settings -- that is what the data told us. We believe the landing gear is designed for Backfire and the conditions under which it must operate. Our analysis determines the fuel weight which Backfire can reasonably carry.

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[] There is only one other Soviet supersonic bomber, and its estimated fuel volume utilization is even less efficient than we show for Backfire.

Thus, by selectively limiting data to be analyzed to near single source, by adhering rigorously to a set of questionable assumptions and judgments that can only have a range-degrading effect upon final results, and by not considering technical, historical, or logical precedents, the [] analysis has driven performance of the Backfire to ranges significantly below those derived by Boeing, North American Rockwell, General Dynamics, RAF, and USAF strategic bomber design engineers.

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This is also a total misstatement. Our data base is much larger than those used for any prior analysis. We have not adhered rigorously to any prior assumptions. The limited number of assumptions which we have made have been subjected to rigorous checking and cross-checking to obtain reasonableness and balance. The resulting range degradation is a result of our finding that the assumptions which we previously made and which FTD and their contractors continue to make would not correlate with telemetry observations. It is Air Force and their contractors, therefore, who are adhering rigorously to a set of questionable assumptions and judgments that tend to maximize the aircraft performance. Our Backfire performance model is very consistent with technical, historical and logical precedents. It is especially consistent with Soviet precedents.

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NOCONTRACT-	Not Releasable to Contractors or Contractor/Consultants
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